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ABSTRACT

This study sought to determine the levels of persistence in scanning postings that are typical of users of one online public information system, LCS (Library Computer System), as it was configured in Illinois in 1987. The study involved observation of users doing searches in an academic library, questioning them about what they had done, and then analyzing the system transaction log of those searches. The users' reports about their searches were then compared with the machine-recorded transcriptions of those searches. Major findings of the study include: (1) users reporting overload also reported finding a significantly smaller number of postings than other users and were likely to have experienced overload in the past, suggesting that they have information processing capacities or search styles that inhibit their persistence; (2) the median number of postings considered to be "too many" by all of the users was 15; (3) more users whose searches retrieved between 15 and 30 postings displayed records of all postings than ceased searching without displaying any records; and (4) users' persistence falls off significantly when the number of postings exceeds more than 30. These findings suggest that surveying users about their preferences for the length of a list of references they are willing to scan on an online public information system will underestimate their persistence in actually scanning lists of references. They also suggest that system designers may defer providing help for users in coping with large number of postings until that number reaches 30. A copy of the user questionnaire is appended. (6 references) (BBM)

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User Persistence in Scanning LCS Postings:

A Report to the Council on Library Resources

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April 11, 1989

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Executive Summary

User persistence in searching for information is an important aspect of information-seeking behavior. Because much information-seeking is discretionary -- the user faces no penalty for failure to find information sought -- too long a set of postings may cause the user to abandon a search. Discussions of design of online information systems have recognized this possibility and have recommended that systems help users once the number of postings their searches retrieved exceeds a certain level. But none of these recommended levels is based on research.

This study seeks to determine what levels of persistence in scanning postings are typical of users of one online public information system, LCS (Library Computer System), as it was configured in Illinois in 1987. The study observed users doing searches, questioned them about what they had done, and then analyzed the system transaction log of those searches. By combining analysis of what the users reported about their searches with analysis of the machine-recorded transcription of those searches, the investigators compared users' reports with their behavior.

Major findings of the study are:

1) Users reporting overload also reported finding a significantly smaller number of postings than other users; furthermore, users reporting overload were likely to have experienced overload in the past. Both these suggest that overloaded users have information processing capacities or search styles that inhibit their persistence.

2) Among all users responding to the questionnaire (both those reporting overload and those not reporting overload) the median number of postings considered to be "too many" was 15.

3) Although 15 postings was generally considered to be too many, among users whose searches retrieved between 15 and 30 postings, more users displayed records of all postings than ceased searching without displaying any records.

4) Users' persistence falls off significantly when the number of postings exceeds 30. When a search retrieves 30 or fewer postings, a majority of users displays all postings. When a search retrieves more than 30 postings, a majority of users displays no records.

If these findings can be generalized to other systems, they suggest that surveying users about their preferences for the length of a list of references they are willing to scan on an online public information system will underestimate their

persistence in actually scanning lists of references. The findings also suggest that designers of systems may defer providing help for users in coping with large numbers of postings until that number reaches 30.

The findings are limited because LCS contains a design feature that seems to inhibit users from successfully persisting in their searches. Instead of displaying postings by a series of numerically consistent commands, the user displays postings by issuing commands of PG2, PG3, PG+, PG2, PG3, PG+, etc. Review of the transaction logs shows that many users do not employ the PG+ command correctly, but use PG4, PG5, and the like. (The present study's analysis of the transaction log compensated for this design feature.)

Despite this design feature, the version of LCS used is good for a study of persistence because it displays postings in no apparent order. In this sense, it provides a baseline against which to compare users responses to other systems that display postings in various types of helpful order, (e.g., alphabetical and reverse-chronological).

1.0 Introduction

How long users are willing to persist in scanning displays of postings is an important question for designers of machine-driven information systems. The term postings means in some contexts the number of records that a search retrieves; in other contexts, it means the records themselves. A system may display the number alone or it may display the number in combination with one or more full or truncated postings or with a guide to the postings. If all the full or truncated matches cannot be displayed at once, the user faces a decision about expenditure of time: is it worth the time to look at additional postings to find the information sought? Because, as Wiberley and Daugherty have argued, much information seeking is discretionary -- users may abandon a search without fear of penalty -- too large a number of postings may influence a user to stop searching.[1] Discussions of information-system design sometimes suggest a number of postings beyond which the system should provide prompts, helpful orders, and other mechanisms to help users cope with the postings.[2] None of these numbers, as far as we can tell, derives from research.

Presumably each time a user conducts a search, he or she is willing to persist in scanning a limited number of postings. (This limited number is not necessarily a small number.) It seems fair to assume that a given user will have a different

limits in different situations. And across a population of users, limits will vary from person to person as well as from time to time. But for the designer of an information system, it would be useful to know the range of persistence. This is particularly true of information systems like online public access catalogs (OPACs) which are open to all persons and do not require sign-ons or passwords that might load into the system a profile of the user's tendencies and proficiency. Such systems must meet the needs of the public in all its variety. Heretofore, there has been no research reporting users' behavior on which to base design of system features that help users deal with large numbers of postings. This report describes a study that attempted to determine the thresholds of persistence for users of one information system, LCS (Library Computer System), as it was configured in Illinois in 1987.

At the time this study was conducted, LCS (since enhanced) was an online library system providing author, title, author/title, and call number access to library collections. This investigation of use of LCS was conducted in an academic library that had loaded approximately 425,000 records into the system at the time of the study. While users had access to more than 25 other databases the largest of which was approximately 3,300,000 records, 80 percent of the searches were conducted on the local database. The overall plan of the study called for observing when a representative sample of users began and ended

their sessions at LCS terminals. After the sessions, project staff gave these users a questionnaire about their experience in searching the system, asking particularly if the number of postings found was too many. The questionnaire asked about past use of LCS and other computer systems, and requested personal profiles, like those gathered for the Council on Library Resources (CLR) sponsored Online Public Access Catalog (OPAC) project.[3] The investigators developed the questionnaire with the assistance of the University of Illinois Survey Research Laboratory (SRL). It was pre-tested on SRL employees and library users. Finally, the investigators analyzed transaction logs of the sessions to verify the users' recollections and to note other characteristics of user behavior.

This study has cast the problem of overload in terms of numbers of postings instead of either number of screens of display or elapsed time of searching. While the latter two may ultimately prove more meaningful frames of analysis, numbers of postings is best for an initial investigation of the problem because system designers have discussed the problem of overload in terms of number of postings.

2.0 Sampling Plan

The sampling plan followed the model designed for the OPAC

project sponsored by CLR.[4] User sessions were observed and questionnaires distributed at terminal locations -- sites of a single terminal or cluster of terminals. Terminal locations were studied on a scheduled basis, each location at least once. The data collection period was the ten-week academic quarter of winter 1987 (5 January - 13 March 1987). Each day of the quarter was divided into three four-hour time blocks: morning, 9 a.m.-1 p.m.; afternoon, 1 p.m.-5 p.m.; and evening, 5 p.m.-9 p.m. Data on numbers of transactions for January through March 1986 showed that the morning and afternoon time blocks for Monday through Friday were the ten highest periods of activity. Observation during these ten time blocks was then assigned to terminal locations in proportion to level of activity; the more heavily used a location, the more time alloted for observation of sessions and questionnaire distribution at that location. Thus, a site of three terminals near the reference desk had the most activity and was subject to more hours of observation than any other site. Assignment of time blocks for observation at the different sites was done by random sampling techniques.

Research assistants observed the beginning and ending of the first user-session in a time block, and, at the session's end, gave the user a questionnaire. The assistants then repeated this process for each succeeding user whose entire session could be observed. Thus, assistants did not question users who began their sessions when another user was being observed. In short,

users sampled were individuals who were observed by the research assistants, working at an LCS terminal at a designated terminal location during the data collection period during the randomly assigned time blocks. Excluded from this study were individuals using the system via dial access from remote terminals.

The target sample size was 1,300. This assumed five usable sessions per hour, an assumption based on observation of activity at terminal locations in spring 1986 and a response rate comparable to that in the CLR studies. The total number of time blocks assigned was 78 or 312 hours. Of the users sampled in the CLR studies, about 17% reported finding too much information.[5] Based on these data, the present study expected to cover 221 cases where too many matches were found. A factor which was expected to have an effect on response, but whose extent could not be projected was migration of users from LCS to LUIS, the Library's NOTIS-based OPAC. When the study team observed activity at terminals in spring 1986, LUIS had been available to the public for only a month. In the following seven months the library's clientele had gained increasing familiarity with LUIS, and many users were attracted to the newly-installed system.

3.0 LCS Displays

LCS gives users access to a file of bibliographic records

through general searches and detailed searches. The user constructs general search keys from elements of the author's name and/or the title of the item sought. The system responds with a listing of any items matching the search key. (See Figure 1.) If no items are retrieved, there are no listings. If only one item is retrieved, the system displays a detailed record (described below). If more than one item is retrieved, the system displays general records. Each general record is one line long and shows author, title, and publication place and date. Author, title, and place may be truncated to fit the single line. Up to ten general records are displayed at one time in units called pages. The user may page through the postings, ten at a time, or may skip ahead by specifying the number of matches to skip. Because matches are not displayed in any apparent order, however, the user has no basis upon which to guess how far into the listing a desired item may fall. At the top of the first page, the system displays the number of items matching the search key so the user knows at the outset how many postings are retrieved.

Detailed searches are typically constructed with a line number of a posting displayed in a general search or by using the call number, if it is already known. The result of a detailed search is a detailed record that includes the call number, author and title, place and date of publication, holdings, location, date added to database, and circulation information (i.e., availability.) (See Figure 2.)

Figure 1

General Search Statement and General Records

AUT/GRABERDOR *General Search Statement*

PAGE 1 6 MATCHES 0 SKIPPED (ALL DISPLAYED IN 1)

01	GRABER, DORIS A. (DORIS APPEL),	VERBAL BEHAVIOR AND POLITICS $URBANA	1976
02	GRABER, DORIS A. (DORIS APPEL),	MASS MEDIA AND AMERICAN POLITICS $WASH	1980
03	GRABER, DORIS A. (DORIS APPEL),	PROCESSING THE NEWS $NEW YORK	1984
04	GRABER, DORIS A. (DORIS APPEL),	CRIME NEWS AND THE PUBLIC $NEW YORK	1980
05	GRABER, DORIS A. (DORIS APPEL),	PUBLIC OPINION, THE PRESIDENT, AND FOR	1968
06	GRABER, DORIS A. (DORIS APPEL),	MASS MEDIA AND AMERICAN POLITICS $2D	1988

General Records

Figure 2

Detailed Search Statement and Detailed Record

DSL/3 *Detailed Search Statement*

HM261G781984 GRABER, DORIS A. (DORIS APPEL), 1923-
PROCESSING THE NEWS $NEW YORK 83-10537
388409 1984 1 ADDED: 840614
01 001 3W MAI RNEWD 860501/870222 CC

Detailed Record

4.0 Identifying Transaction Log Records of Observed Sessions

Because users do not indicate when they begin or end LCS sessions, project staff observed the sessions. Staff kept an observer log and recorded (1) the beginning time of the session (2) the ending time of the session; (3) the terminal ID of the specific terminal used; and, (4) the gender of the user. Observers used clocks synchronized with LCS at the start of the project; synchrony was verified during the survey. There were several challenges in noting exactly when sessions began and ended. In order to be unobtrusive, observers were stationed between eight and thirty feet from the terminal sites. Traffic between them and the users could distract them from observing exactly when users first issued a search command. Noting the end of a session was complicated by two factors. First, the observer did not know a session was over until the user left the terminal, but the user might remain at the terminal for some time after issuing a final command. Second, the observer had to distribute the questionnaire as soon as the user left the terminal.

Comparison of the system transaction log and the observer log revealed discrepancies between the two for many sessions. Because of these discrepancies, observed sessions in the transaction log were identified by scanning the log for the terminals and times observed. To facilitate correlation of the transaction log with the observer log, the chronological

transaction log was sorted, first, by terminal ID and then chronologically for each terminal. Terminal IDs and beginning and ending times from the observer log were programmed to interfile in the transaction log.

Only 81 of 748 (11%) observed sessions could not be correlated with transaction log activity. Generally correlations were straightforward. In these cases of correlation, the transaction log recorded a discrete block of activity that began exactly at or within two minutes of a session beginning time recorded by an observer. This block of activity was either separated by three or more minutes from other activity or it was distinguished by its content, that is, search keys were repeated or search keys apparently seeking the same authors or titles were used.

Careful inspection of the transaction log and comparison of it with the observer log indicated the occasional difficulties the observers had in noting when users first and last entered a command in their sessions. There were 14 cases where the observer apparently recorded a beginning time for a session as soon as the user arrived at the terminal, but the user did not enter a command for three to six minutes. Also, there were 28 cases where the absence of activity in the transaction log suggested that a user lingered for three to six minutes at a terminal without entering a search key, leading the observer to

record an ending time several minutes after the user had issued the last command of the session.

There were 41 cases where the observer entered the wrong terminal ID into the log. These errors were identified when no discrete activity could be found at the terminal recorded, but transactions fitting the criteria for straightforward correlations outlined above, were identified at an adjacent terminal. There errors were understandable because terminal IDs were easily confused, e.g. number sequence in one location was left to right, in another right to left. Future projects might better use a graphic representation on observer log forms and ask observers to circle an icon of the terminal in use, rather than circle the ID.

Also, in 15 cases continuity of the transaction log (at least one command every minute and all commands repeating or very closely resembling each other) indicated the observers had recorded starting times in the middle of sessions clearly already in progress. While the observers were not supposed to record sessions already in progress, the investigators saw no reason to eliminate the beginnings of such sessions from the data set when the content of the transaction log demonstrated the continuity of the session.

Finally, there were cases where the transaction log showed

search commands occurring more than two minutes after the observed end of the session, that repeated or very closely resembled search commands that were executed during the observed session. If such continuity of content was also accompanied by temporal continuity (at least one command per minute and the sequence of commands beginning within two minutes of the observed end of the session), the end of the session was identified as the end of this continuity.

5.0 Editing the Transaction Log

Program documentation for LCS available at the outset of the project stated that the transaction log recorded both the user's input and the system's response of the number of postings retrieved. That is, if the user conducted an author search for a book by Doris Graber (see Figure 1) the transaction log would record the search and that six matches or postings were retrieved. In fact, the transaction log did not record the number of postings retrieved. The absence of these data forced the project team to reconstruct all searches that might have retrieved matches. In addition, since this reconstruction took place more than a year after the observed searches, it was necessary to perform detailed searches on each record retrieved to determine when it was added to the database. The number of records added after the date of the observed session was

subtracted from the total found in the reconstruction. The corrected totals, then, were the same as those seen by the users. These totals were used in the analysis of the transaction log.

Some records were also deleted from the database between the months when sessions were observed and the time when the searches were reconstructed. Although it was not possible to correct reconstructed searches to compensate for deletions, the number of deletions was estimated to be so small that it has little effect on this study's results. Library staff at the site library who edited their database reported that they normally deleted fewer than 40 records each month -- less than one hundredth of one percent of the database. We have no reason to believe that other libraries' databases had significant deletions.

6.0 Methods of Data Analysis

This study worked with two kinds of data: (1) questionnaire data that included the user's (a) report about what happened in the observed session and (b) response to questions about his or her academic background and past use of computers, libraries, and library systems; and (2) transaction log data that provided a system-recorded transcription of the user's activity on the system that was supplemented by the investigators with the number of postings retrieved by correctly formatted searches. Each kind

of data was analyzed separately, and then the two data sets were combined and analyzed.

6.1 Method of Analysis of Questionnaire Data

Determination of (1) limits of persistence and (2) preferred number of postings, from questionnaire data alone was straightforward. All responses were keyed to disk using the software package, PC-Enter. Then they were uploaded to a mainframe and analyzed using SPSS-X, version 3.0 installed December, 1987 and operating on an IBM 3081K, running VM/CMS. Frequencies, cross-tabulations, and correlations were run as appropriate for the types of variables.

6.2 Method of Analysis of Transaction Log Data

Determination of levels of persistence and of overload from transaction log data alone is an inferential process, far more complicated than analysis of questionnaire data. Transaction log analysis depends on a set of assumptions about what constitutes normal user behavior. We assume, as do other catalog studies, that users search a catalog to find a call number of a known item or a call number to serve as a starting point for shelf searching for books about a subject.[6] Because call numbers are found in

detailed LCS records, this assumption means that, with LCS, a user who is not overloaded will find and display at least one detailed record if his or her search retrieves the known item sought or an item that the user thinks is about the subject sought. We assume that if a search does not retrieve an item a user seeks, then the user who is not overloaded will exhaust all possibilities by displaying general records for all items retrieved.

Given the design of LCS, an investigator can infer persistence or overload only in searches that retrieve more than ten postings. No inference can be drawn for searches that retrieve ten or fewer postings, because the system automatically displays up to ten general records when retrieved. For searches that retrieve more than ten postings, the user can display general records in groups of up to ten, until general records are displayed for all postings retrieved. For example, if a search retrieves 37 postings, the system automatically will display general records for postings 1-10; the user can then choose to display general records for postings 11-20, 21-30, and 31-37. For a user who displays postings 11-30 and displays no detailed record, we can infer a level of persistence of 30. Similarly, for a user who displays all 37 postings, we can infer a level of persistence of 37.

For a user whose search retrieves more than 10 postings, but

issues no command to display more general records and no command to display a detailed record, we can say only that his or her reaction to this number of postings exhibits overload. Similarly, users who display some, but not all, general records retrieved also exhibit overload for the level of postings retrieved. But members of the latter group also exhibit levels of persistence equal to the number of postings each displays. This would be the case for the person who displays 30 of 37 records retrieved.

The designer of a public information system must ask at what level a system should help users cope with the number of postings retrieved because it is too large. We would posit this level or threshold for help should be the number of postings above which more users exhibit overload than exhibit persistence. In spelling out what this means, we point again out again that no inference can be drawn for searches that retrieve ten or fewer postings, because this system automatically displays up to ten general records when retrieved. Thus, at each level of postings above ten, the number of overloaded users (those who do not display any detailed records nor any general record) must be compared with the number of persistent users (those who display all general records or some general records but no detailed records).

In interpreting the transaction log, the investigators took

into account the structure of commands for displaying general records. Instead of displaying general records by a series of numerically consecutive commands, the user displays these records with commands of PG2, PG3, PG+, PG2, PG3, PG+, etc. for records 11-20, 21-30, 31-40, 41-50, 51-60, 61-70 respectively (1-10 are automatically displayed). Figure 3 illustrates use of the PG+ command to display postings 31-37 in a search that retrieves 37 postings. Because the transaction log strongly suggested that many users attempted to persist but were unsuccessful in efforts to display more general records because they issued incorrect PG commands, the investigators decided to develop rules to give credit for such effort. First, users received credit when they issued a PG command with an illegal number (since given the results of using PG2 and PG3, it is reasonable to assume PG4 displays general records 31-40; PG5, 41-50, etc. Second, credit was given for the first illegal repetition of a PG+ command, because it would be reasonable to assume PG+ displays in groups of ten all records beyond 30, until illegal use of the command shows this is not always the case. We call an interpretation of the transaction log that gives users credit for such incorrect commands that are apparent efforts to display additional general records a liberal interpretation. In Tables 1-4 a liberal interpretation is designated by an open circle (o) in contrast to a solid circle (•) where the user issued a correct series of commands to display general records.

Figure 3

Commands that Display General Records

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TLS/CLINCHEMI

 PAGE 1                    37 MATCHES          0 SKIPPED     (NOT ALL DISPLAYED)
01                                            CLINICAL CHEMISTRY                      1955
02                                            JOURNAL OF CLINICAL CHEMISTRY AND CLIN  1963
03 GRAY, C.  H.  (CHARLES HORACE)             CLINICAL CHEMICAL PATHOLOGY $10TH ED.   1985
04 SYMPOSIUM ON THE CLINICAL CHEMIS           THE CLINICAL CHEMISTRY OF MONOAMINES.$  1963
05                                            CLINICAL CHEMISTRY $ST. LOUIS           1984
06 ZILVA, JOAN FOSTER                         CLINICAL CHEMISTRY IN DIAGNOSIS AND TR  1975
07 HENRY, RICHARD JOSEPH                      CLINICAL CHEMISTRY$NY                   1964
08 BOUTWELL, JOSEPH H.                        CLINICAL CHEMISTRY$PHILA                1961
09 GRAY, CHARLES HORACE.                      CLINICAL CHEMICAL PATHOLOGY.$LOND       1953
10 KANTER, MURIEL W.                          CLINICAL CHEMISTRY $IND                 1975

PG2

 PAGE 2                    37 MATCHES          0 SKIPPED     (NOT ALL DISPLAYED)
11 ZILVA, JOAN F.                             CLINICAL CHEMISTRY IN DIAGNOSIS AND TR  1971
12 HENRY, RICHARD J., 1918- ED.               CLINICAL CHEMISTRY: PRINCIPLES AND TEC  1974
13 GRAY, CHARLES HORACE.                      CLINICAL CHEMICAL PATHOLOGY.$6TH ED.$L  1971
14 REYNOLDS, MOIRA DAVISON.                   CLINICAL CHEMISTRY FOR THE SMALL HOSPI  1969
15 STEWART, CORBET PAGE.                      CLINICAL CHEMISTRY IN PRACTICAL MEDICI  1962
16 ANNINO, JOSEPH S.                          CLINICAL CHEMISTRY$2D ED.$BOST          1960
17 BOLD, A. M.                                CLINICAL CHEMISTRY $OX                  1975
18 HINGERTY, DANIEL.                          CLINICAL CHEMISTRY OF THE ADRENAL MEDU  1972
19 GRAY, CHARLES HORACE.                      CLINICAL CHEMICAL PATHOLOGY.$5TH ED.$L  1968
20 RICHTERRICH, ROLAND                        CLINICAL CHEMISTRY$BASEL                1969

PG3

 PAGE 3                    37 MATCHES          0 SKIPPED     (NOT ALL DISPLAYED)
21 GRAY, CHARLES HORACE.                      CLINICAL CHEMICAL PATHOLOGY$8TH ED.$LO  1977
22 ANNINO, JOSEPH S.                          CLINICAL CHEMISTRY : PRINCIPLES AND PR  1976
23 RICHTERRICH, R. (ROLAND), 1927-19          CLINICAL CHEMISTRY $CHICHESTER          1981
24 KAPLAN, ALEX, 1910-                        CLINICAL CHEMISTRY$ 3RD ED.$ PHILADELP  1988
25 GRAY, CHARLES HORACE.                      CLINICAL CHEMICAL PATHOLOGY $9TH ED. $  1970
26 ROBINSON, RONALD.                          CLINICAL CHEMISTRY AND AUTOMATION$BALT  1971
27 ANNINO, JOSEPH S.                          CLINICAL CHEMISTRY$3D ED.$BOST          1964
28 GRAY, CHARLES HORACE.                      CLINICAL CHEMICAL PATHOLOGY$5TH ED.$LO  1968
29 GRAY, CHARLES HORACE.                      CLINICAL CHEMICAL PATHOLOGY.$3D ED.$BA  1963
30                                            CLINICAL CHEMISTRY$WASH DC              1976

PG+

 PAGE 1                    7 MATCHES           0 SKIPPED     (NOT ALL DISPLAYED)
01 WOODROW, DEREK A.                          INTRODUCTION TO CLINICAL CHEMISTRY $LO  1987
02 ANNINO, JOSEPH S.                          CLINICAL CHEMISTRY$BOST                 1956
03 BOLD, ALAN MAURICE.                        CLINICAL CHEMISTRY COMPANION $OXFORD    1978
04 KAPLAN, ALEX, 1910-                        CLINICAL CHEMISTRY $PHILADELPHIA        1979
05 STEWART, CORBET PAGE.                      CLINICAL CHEMISTRY IN PRACTICAL MEDICI  1937
06 ARNOLD O. BECKMAN CONFERENCE IN            CLINICIAN AND CHEMIST $WASHINGTON       1979
07 KAPLAN, ALEX, 1910-                        CLINICAL CHEMISTRY $2ND ED. $PHILADELP  1983
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After the two investigators most familiar with LCS had established the method described here for inferring levels of persistence and overload from the transaction log, they analyzed, independently, the segments of the transaction log for each session observed. They then compared these independent analyses and reconciled by careful review of the log, any differences in the independent analyses.

In some of the observed sessions, users' searches retrieved more than ten postings more than once. For this report, the investigators analyzed the user's reaction to only the highest number of postings retrieved. This approach assumes that persistence in displaying the higher number is more noteworthy and that users presumably had the highest number of postings in mind when answering questions about whether they found too many in the session.

In some sessions, searches retrieved more than once the highest number of postings found in the session. In these cases the investigators analyzed (and report in Tables 1-4 below) the user's response that showed the most persistence. For example, in one session immediately after a search key retrieved 32 postings, the user tried different search keys that retrieved

smaller numbers of postings, then reentered the search key that retrieved 32 postings, and finally displayed general records of all 32 postings. The investigators classified this as a case of total persistence in scanning 32 postings. While the user may not have persisted initially, he or she did try alternate search keys (a variant manifestation of persistence), and, ultimately, within the same session, did persist in scanning the 32 postings.

6.3 Method of Analysis of Questionnaire and Transaction Log Data Together

For cases where users responded to the questionnaire, the investigators examined the transaction log to compare users' behavior with their reports about what happened during their sessions. This comparison focused on how the user reacted to the largest number of postings retrieved during the session. As stated above, users presumably had the largest number of postings in mind when they answered questions about whether they found too many postings. After interpreting the transaction log to identify cases where the users' reactions were either of overload or of total persistence to the largest number of postings retrieved in a session, the investigators then compared the characteristics, ascertained by the questionnaire, of users in the two groups.

7.0. Results of Data Analysis

7.1. Results of Analysis of Questionnaire Data

The analysis of questionnaire data showed that 418 of the 748 users who were observed returned a completed questionnaire (a return rate of 56%). Of these 418, 44 or 11% reported they experienced overload during the observed sessions. Analysis of these users' responses shows that 13 postings was the median number reported to be too many. Of all respondents, 35% reported that they had experienced overload at some time. Two hundred seventy-two users or 65% (both those who had and some who had not experienced overload) responded to the question, "In general, how many matches [postings] would you consider to be 'too many.'" The median response was 15 postings.

Search overload is significantly correlated with a lower number of postings found. This suggests that overloaded users may have lower thresholds. Is this overload specific to a particular search, or is it a more general user characteristic? We found that specific overload is significantly correlated with having ever experienced search overload ($r = .30$, $p < .001$). The specific and prior number of postings are also positively correlated ($r = .63$, $p < .001$). This suggests that overload potential is to some extent a general user trait. It could be

due to general information processing capacity or to consistent search styles over time, or to a combination.

There are other differences between those who reported overload and other users. Overloaded users reported searching more by title and less by author, author-title combined, subject and alternative strategies (Chi sq. = 11.19, $p < .02$).

There are two other distinctive characteristics of users who reported overload in the session observed. They were significantly more likely to be either very frequent (daily or weekly) users, or very infrequent users (four times per year or less), but not moderately frequent (monthly users) (Chi sq. = 16.53, $p < .01$). Second, all but one of the overloaded users claimed to know how to reduce the number of matches. Regarding users who reported being overloaded in previous sessions, we found that they were significantly less likely to think the order of postings was clear ($r = -.13$, $p < .003$).

7.2 Results of Analysis of Transaction Log Data

Analysis of the transaction log alone shows remarkable instances of persistence, but overall a drop-off in persistence once the number of postings retrieved exceeds 30, and a great drop-off once the number exceeds 60. Tables 1-4 summarize the

evidence. The analysis includes cases of those who did not respond to the questionnaire because their activity can be analyzed in the same way as the activity of respondents.

In the tables, reactions of users are divided into three categories. The category of users in column (2) is those who presumably were overloaded by the number of postings they encountered: they displayed no general records after the system finished automatically displaying the first ten and they displayed no detailed records. Column (3) gives data on users who showed total persistence by examining all possibilities among the postings they retrieved by displaying all general records beyond the first ten. They were totally persistent. Column (5) also shows extent of persistence of users who displayed some, but not all, of the general records retrieved by their searches. The persistence of users reported in column (5) is comparable to that in column (3).

The patterns of reactions to different levels of postings in relation to other data found in this study suggest the following recommendations for designers of information systems. In relation to users' reports of their preferences for limits in numbers of postings, the median expressed preference of 15 appears to be significantly lower than the number with which many users will work. Of 83 users in Table 4 whose searches retrieved 15 or more postings, 47 (57%) in some way persisted by displaying

more than 15 general records. Of the 47 cases in Table 4, where searches retrieved between 15 and 30 postings, only 14 (30%) displayed no general records. A majority of users do not exhibit overload until the number of postings retrieved exceeds 30. The need to use PG+ to display postings beyond 30, may inhibit persistence beyond that level. Liberal interpretation of the transaction log tries to compensate for this, but study of users' persistence on other systems where it is easier to display more than 30 postings will be needed to test this finding.

7.3 Results of Analysis of Questionnaire Data and Transaction Log Data Combined

Analysis of the transaction log and questionnaire data together offers a valuable perspective on user persistence. First, 11 of the 44 (25%) users who reported finding too many postings (i.e., were overloaded) did searches that retrieved either no postings or only one posting, and thus saw everything their searches had to offer. Their reports do not fit a common sense understanding of the meaning of too many postings. This suggests possible confusion in use of the system or misunderstanding of the questionnaire. Second, of the 18 users who reported overload and whose searches retrieved more than ten postings, five (28%) displayed all general records. This suggests that some users feel overloaded, but it does not prevent

them from persisting through a list of postings they consider too long.

Some users who reported they were not overloaded also behaved in a way not consistent with their report about what they had done. Of the 53 who did not report overload, whose searches retrieved more than ten postings, and who were not partially or totally persistent, 19 (36%) did not display any detailed records nor any general records after the first ten that the system displayed automatically. Another four displayed some, but not all of the general records after the first ten and no detailed records. By not seeking a detailed record and by not displaying any additional general records, these users were abandoning their searches before exhausting all possibilities.

Analysis of questionnaire responses of users who either reacted as if they were overloaded (i.e., displayed no records) or totally persisted (i.e., displayed all general records) revealed no differences between the two groups.

8.0. Conclusions

The study's findings suggest that surveying users about their limits in scanning a list of references on an online public information system will identify a median limit that

Table 1

Reactions of Overload and Levels of Persistence
Among Users Who Reported Overload

(1) Highest Number of Postings Retrieved in Session	(2) Number of Users Who Displayed No General Records and No Detailed Records (Overloaded)	(3) Number of Users Who Displayed All General Records (Totally Persistent)	(4) Number of Postings Displayed by Partial Persisters*	(5) Number of Users Who Displayed Some General Records and No Detailed Records (Partially Persistent)
11-14		• •	11-14	
15-20		•	15-20	
21-30	• •	•	21-30	• o
31-40			31-40	
41-50		o	41-50	•
51-60			51-60	
61-	• •		61-	

• User issued correct commands (p. 24)
o User issued some incorrect commands (p. 24)

*Partial persisters displayed only some of the postings retrieved

Table 2

Reactions of Overload and Levels of Persistence
Among Users Who Did Not Report Overload

(1) Highest Number of Postings Retrieved in Session	(2) Number of Users Who Displayed No General Records and No Detailed Records (Overloaded)	(3) Number of Users Who Displayed All General Records (Totally Persistent)	(4) Number of Postings Displayed by Partial Persisters*	(5) Number of Users Who Displayed Some General Records and No Detailed Records (Partially Persistent)
11-14	• • •	• • • • •	11-14	
15-20	• • •	• • • •	15-20	
21-30	• • •	• • • • • • • • •	21-30	• •
31-40	• • • •	o o	31-40	
41-50			41-50	o
51-60	• •		51-60	o
61-	• • • •		61-	

• User issued correct commands (p. 24)
o User issued some incorrect commands (p. 24)

*Partial persisters displayed only some of the postings retrieved

Table 3

Reactions of Overload and Levels of Persistence
Among Users Who Did Not Respond to the Questionnaire

(1) Highest Number of Postings Retrieved in Session	(2) Number of Users Who Displayed No General Records and No Detailed Records (Overloaded)	(3) Number of Users Who Displayed All General Records (Totally Persistent)	(4) Number of Postings Displayed by Partial Persisters*	(5) Number of Users Who Displayed Some General Records and No Detailed Records (Partially Persistent)
11-14	• • • • • •	• • • • • •	11-14	
15-20	• • •	• • • •	15-20	• •
21-30	• • •	• • • • • •	21-30	
31-40	• • • •	• o	31-40	
41-50			41-50	• o
51-60	•	o	51-60	
61-	• • • • •	o	61-	o o

• User issued correct commands (p. 24)
o User issued some incorrect commands (p. 24)

*Partial persisters displayed only some of the postings retrieved

Table 4

Reactions of Overload and Levels of Persistence
Among Users Who Reported Overload, Did Not Report Overload, and Did Not Respond to the Questionnaire

(1) Highest Number of Postings Retrieved in Session	(2) Number of Users Who Displayed No General Records and No Detailed Records (Overloaded)	(3) Number of Users Who Displayed All General Records (Totally Persistent)	(4) Number of Postings Displayed by Partial Persisters*	(5) Number of Users Who Displayed Some General Records and No Detailed Records (Partially Persistent)
11-14	● ● ● ● ● ● ● ● ●	● ● ● ● ● ● ● ● ● ● ● ●	11-14	
15-20	● ● ● ● ● ●	● ● ● ● ● ● ● ●	15-20	● ●
21-30	● ● ● ● ● ● ● ●	● ● ● ● ● ● ● ● ● ● ● ● ● ● ●	21-30	● ● ● o
31-40	● ● ● ● ● ● ● ●	● o o o	31-40	
41-50		o	41-50	● ● o o
51-60	● ● ●	o	51-60	o
61-	● ● ● ● ● ● ● ● ●	o	61-	o o

● User issued correct commands (p. 24)
o User issued some incorrect commands (p. 24)

*Partial persisters displayed only some of the postings retrieved

underestimates the persistence of a majority of users. Although 15 is the median number of postings that users say is too many, when searches retrieved between 15 and 30 postings, more users displayed records of all postings retrieved than ceased searching without displaying any records.

Because system intervention to help users cope with overload can degrade system performance in other areas, designers of information systems will want to defer helping users with large numbers of postings as long as possible. The findings of this study suggest most users do not need such help until the number of postings exceeds 30. Users' persistence falls off significantly when the number of postings retrieved exceeds 30. While a majority of users displays all general records for searches that retrieve between 11 and 30 postings, when searches retrieve more than 30 postings, a majority of users displays no records.

One might argue that, although a majority of users displays records for all postings when a search retrieves between 15 and 30 postings, a substantial proportion (14 of 47, or 30%) do not display any records and the needs of this minority should be recognized. There are two arguments against this. First, as stated above, provision of help is costly and should be minimized to save resources when possible. Second, analysis of the self-reported characteristics of users suggests that those who are

overloaded are overloaded at very low levels of postings, and, even when they apparently know how to reduce the number of postings retrieved, are unwilling to do so.

The findings of this study are limited because LCS's design seems to inhibit some users from successfully persisting in their searches. While the study's analysis of the transaction log attempted to compensate for LCS design, investigation of users' reactions to other systems will be needed to confirm this study's findings. At the same time, the findings of this study serve in one way as a baseline for investigations of persistence: unlike other systems that display postings in helpful orders (e.g. alphabetical by author or reverse chronological), this version of LCS displays postings in no discernible order.

The need to understand users' persistence in scanning postings in machine-readable information systems will always be with us, and probably will increase in significance. The trend is to build larger and larger databases and to make each word in the database retrievable. This will result in databases yielding more and more search results of large numbers of postings. The need to provide users with assistance in coping with these instances of overload will similarly increase. The findings of this study will be modified and extended by future research. But until that the research is done, the results reported here can serve as a guide for system design.

Endnotes

1. Stephen E. Wiberley, Jr. and Robert Allen Daugherty, "Users' Persistence in Scanning Lists of References," College & Research Libraries 49: 149-56 (March 1988).

2. Karen Markey, Subject Searching in Library Catalogs: Before and after the Introduction of Online Catalogs (Dublin, OH: OCLC Online Computer Library Center, Inc., 1984), 103-4. Gary Marchionini and Ben Shneiderman, "Finding Facts vs. Browsing Knowledge in Hypertext Systems," Computer vol. 21: 79 (January 1980). Niall Teskey, "Advanced Interface Management Project Studies Intelligent Assistant Programs," Research Libraries in OCLC: A Quarterly No. 22: 8 (Spring 1987).

3. Karen Markey, Online Catalog Use: Results of Surveys and Focus Group Interviews in Several Libraries. Dublin, OH: OCLC Online Computer Library Center, Inc., 1983 March 31. OCLC Report Number OCLC/OPR/RR-83/3, pp. 36-9.

4. David C. Miller and Daphna Baratz, Data Collection Manual and Sampling Plan (Stanford, CA: Research Libraries Group, 1982) ERIC Document ED 229 015.

5. Markey, Online Catalog Use: Results of Surveys and Focus Group Interviews, p. 74.

6. R. Tagliacozzo and M. Kochen, "Information-Seeking Behavior of Catalog Users," Information Storage and Retrieval 6: 367-8 (December 1970); Markey, Subject Searching in Library Catalogs, pp. 55-61.

USER QUESTIONNAIRE

This is a survey on the use of the Library Computer System (LCS) and how effectively it meets your needs. Please take a few minutes to answer the questions; circle the number next to your answer. Return the completed questionnaire to the box provided.

1. In any of the searches you just performed, did you find too many matches?

Yes	44	12.2%
No	316	87.5
?	1	0.3
NA	57	

(if NO, skip to question 4)

2. In the searches where you found too many matches, what number of matches were there?

Value	Freq.	%	cum.%
1	1	2.2	2.2
2	1	2.2	4.4
3	3	6.7	11.1
4	3	6.7	17.8
5	4	8.9	26.7
6	2	4.4	31.1
8	2	4.4	35.6
9	1	2.2	37.8
10	4	8.9	46.7
12	1	2.2	48.9
13	2	4.4	53.3
22	1	2.2	55.6
24	1	2.2	57.8
25	2	4.4	62.2
30	1	2.2	64.4
31	1	2.2	66.7
32	1	2.2	68.9
35	1	2.2	71.1
37	1	2.2	73.3
40	1	2.2	75.6
41	1	2.2	77.8
42	1	2.2	80.0
45	1	2.2	82.2
50	1	2.2	84.4
87	1	2.2	86.7
100	1	2.2	88.9
101	1	2.2	91.1
127	1	2.2	93.3
214	1	2.2	95.6
247	1	2.2	97.8
5111	1	2.2	100.0
NA	373		

3. In that search, did you search using the author's name, 22 19.8%
the title, 30 27.0
both author and title, 32 28.8

subject, or	14	12.6
other (please specify)	13	11.7
Don't know		
No Answer (NA)	307	

4. In using this system, do you ever find too many matches?

Yes	122	35.3%
No	223	64.5
?	1	0.3
NA	72	

5. In general, how many matches would you consider to be "too many?"

Value	Freq.	%	cum.%
1	1	0.4	0.4
2	4	1.5	1.8
3	3	1.1	2.9
4	18	6.6	9.6
5	23	8.5	18.0
6	11	4.0	22.1
7	4	1.5	23.5
8	5	1.8	25.4
9	3	1.1	26.5
10	41	15.1	41.5
11	15	5.5	47.1
12	2	0.7	47.8
15	10	3.7	51.5
16	1	0.4	51.8
20	25	9.2	61.0
21	7	2.6	63.6
25	6	2.2	65.8
26	2	0.7	66.5
29	1	0.4	66.9
30	22	8.1	75.0
31	10	3.7	78.7
35	1	0.4	79.0
36	2	0.7	79.8
40	8	2.9	82.7
41	1	0.4	83.1
45	1	0.4	83.5
50	14	5.1	88.6
51	1	0.4	89.0
60	3	1.1	90.1
75	4	1.5	91.5
80	2	0.7	92.3
81	1	0.4	92.6
100	10	3.7	96.3
150	2	0.7	97.1
176	1	0.4	97.4
200	1	0.4	97.8
201	1	0.4	98.2
300	1	0.4	98.5
500	1	0.4	98.9
715	1	0.4	99.3

1000	1	0.4	99.6
2000	1	0.4	100.0
NA	146		

6. In using this system, how often do you find what you're looking for?

Less than half of the time	115	32.7%
More than half of the time	237	67.3
No Answer (NA)	66	

Here are some questions abouty how often you use libraries and library systems.

7. Of the following, which comes closest to describing how often you use a library--any library at all?

Daily	115	31.5%
weekly	183	50.1
monthly	47	12.9
about 4 times a year	14	3.8
about once a year	3	0.8
never before today	3	0.8
Don't know		
No Answer (NA)	53	

8. Of the following, which comes closest to describing how often you use this system (LCS) by dial-access, ADN, or in a library?

Daily	44	12.1%
weekly	172	47.3
monthly	81	22.3
about 4 times a year	28	7.7
about once a year	4	1.1
never before today	24	6.6
Don't know	11	3.0
No Answer (NA)	54	

9. In general, which comes closest to describing how often you use computer systems other than these library systems?

Daily	81	22.6%
weekly	103	28.7
monthly	71	19.8
about 4 times a year	49	13.6
about once a year	27	7.5
never before today	14	3.9
Don't know	14	3.9
No Answer (NA)	59	

Here are some questions about the display of multiple matches in this system.

10. Where more than one match is displayed, would you say that scanning through the display is

easy, or	273	78.4%
difficult?	75	21.6
NA	70	

11. Would you say that the matches were displayed in an order that is

clear	279	79.9%
not clear?	70	20.1

NA 69

12. Would you say that the displays are in a format that is

easy to understand, or	260	74.1%
difficult to understand?	91	25.9
No Answer (NA)	67	

13. Do you know how to reduce the results when there are too many matches?

Yes	166	47.0%
No	186	52.7
NA	65	

14. In this session, what was the main purpose of you library research?

Was it for a course you are taking,	155	42.7%
a course you are teaching,	11	3.0
thesis or dissertation research,	56	15.4
independent research, or	74	20.4
recreational reading?	18	4.6
Other:	49	13.5

15. Of the categories shown here, which best describes your current status?

Freshman/Sophomore	69	19.0%
Junior/Senior	124	33.9
Graduate (Masters)	75	20.5
Graduate (Doctoral)	44	12.0
Graduate (Professional)	6	1.6
Faculty	30	8.2
Staff	4	1.1
Other:	13	3.6
Don't know	1	0.3

16. Of the categories shown here, which best describes you academic area?

Arts & Humanities	77	21.0%
Business	50	13.7
Education	9	2.5
Engineering	81	22.1
Law	6	1.6
Medical/Health Sciences	21	5.7
Physical/Biological Sciences	29	7.9
Social Sciences	51	13.9
Interdisciplinary	1	0.3
Major not declared	7	1.9
Other:	31	8.5
Don't know	1	0.3

17. In what year were you born?

1923	1	0.3%
1924	1	0.3
1926	1	0.3
1935	1	0.3
1937	3	0.9
1938	1	0.3
1939	1	0.3
1940	2	0.6
1941	2	0.6

1942	5	1.5
1943	2	0.6
1944	3	0.9
1945	2	0.6
1946	1	0.3
1947	3	0.9
1948	1	0.3
1949	3	0.9
1950	6	1.8
1951	7	2.1
1952	7	2.1
1953	4	1.2
1954	10	2.9
1955	9	2.6
1956	12	3.5
1957	14	4.1
1958	13	3.8
1959	9	2.6
1960	22	6.5
1961	16	4.7
1962	29	8.5
1963	15	4.4
1964	29	8.5
1965	24	7.1
1966	22	6.5
1967	18	5.3
1968	34	10.0
1969	5	1.5
1971	1	0.3
1984	1	0.3

This is the end of the questionnaire. Thank you for your participation.
Please place the questionnaire in the box provided.